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DISCUSSION
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DISCUSSION OF EAST ST. LOUIS VETERANS MEMORIAL BRIDGE
PROCEEDINGS-SEPARATE 150

W. H. JAMESON,⁵ M. ASCE.—This discussion presents, from the viewpoint of a member of the engineering staff of the fabricator, some of the problems that were encountered in the long-span cantilever crossing the Mississippi River at East St. Louis, Ill. Also the writer will comment on the modification in (b/t) -ratios for components of compression members as used for this structure.

In the case of Mr. Wyly's formula for plate thickness in compression members, there are two points of deviation from standard specifications such as those of the AASHO and the American Railway Engineering Association (AREA) which deserve further study on the part of specification writers. The first is the question as to whether b should be the full width of the plate, or the distance between the nearest lines of connecting rivets. Mr. Wyly has based his decision to use the full width on the test reports on compression plates for the Delaware River Bridge at Philadelphia, Pa.; the writer believes that there is so much scatter in these test results that either value of b could be used logically, and he recommends that further testing should be carried out, probably in connection with the program of the Column Research Council.

The other question involves the use of a formula that omits all consideration of the allowable unit stress. The allowable unit stress determined by any usual column formula is supposed to be that average unit stress on the section which will keep the maximum unit stress on the extreme fiber within the stress determined by dividing the yield point of the material by the factor of safety. Therefore, in the case of a member with an actual unit stress and an allowable unit stress of the same value, no change in the (b/t) -ratio should be permitted—no matter how small this unit stress may be—because a plate situated at the extreme fiber may be considered already stressed to the maximum. It is only when the actual unit stress is less than the allowable unit stress that a change should be permitted, and the method used in the AREA specifications is the theoretically correct method. In the AREA specifications, the (b/t) -ratio for carbon webs is 32 and for carbon cover plates it is 40, but these ratios may be increased by the ratio $(s_{allow}/s_{actual})^{1/2}$. However, the writer agrees with Mr. Wyly's basic requirement that the same limits for b/t should apply to both the webs and the cover plates.

The discourse in the paper concerning the welded shoes at the main piers is an indication of the close cooperation that existed between the consulting engineers and the engineering staff of the fabricator; and it indicates how such cooperation can result in a better structure, usually with a saving in cost. At the main pier of a large cantilever there is always the possibility of developing severe secondary stresses—caused by the rotation of the span as a whole as the live loading moves from main span to anchor arm and by the deformations of the members themselves. After considerable discussion between the consulting engineers and the fabricator's engineers it was decided that it was better to provide for span rotation by using an articulated shoe, as

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shown in Fig. 2, than to attempt to reduce secondary stresses by using pin-ended members at a shoe that could not rotate. Mr. Wyly's measurements, on which the author has provided a preliminary report, but which were not available when this discussion was prepared, should prove whether this procedure has tended to minimize the secondary stresses, and whether rotation of the span as a whole with respect to the pier actually has occurred during erection and concreting and subsequent to completion of the bridge.

Another example of the close cooperation between the consulting engineers and the fabricator's engineers is in the design of the main truss members. For complex reasons, it had been necessary to design these members in a very short time, and without complete study as to how they could be fitted together satisfactorily. After the award of the contract, the members were re-designed to the satisfaction of all parties concerned, and a better structure, with consistent details throughout, was the result. Attention is called to the use of 5-in. by 5-in. angles as the corner angles for nearly all box members. When 4-in. by 4-in. angles, or 6-in. by 6-in. angles with double gages are used, there is always difficulty at chord splices in getting rivets through outstanding 4-in. legs, or through outstanding 6-in. legs on the inner gage line, because of the packing out of splice plates over the web legs of the angles. The use of 5-in. by 5-in. angles, with single gages in each leg, greatly facilitates field riveting and consequently results in better rivets. Some concern was expressed that there would be a tendency for the heel of these 5-in. by 5-in. angles with rivets on a single gage line to pull away from the edge of the web or cover plates. Close inspection of the members revealed no such difficulty, and no special care had to be exercised by the fabricating shop to guard against this.

The design of the floor steel presented some difficulties to the erector, and the solution described here was greatly facilitated by the close cooperation of the consulting engineers. The stringers framed to the floor beam web, in some cases between floor beam stiffeners, and the outstanding legs of these stiffeners made it impossible to erect the stringers by swinging them in. One framing angle for the stringer to the floor beam connection was shop riveted to the floor beam web, and the other was loose. It was decided, therefore, to eliminate vertical stiffeners on one side of the floor beam web, and to use a single longitudinal stiffener on that otherwise plain side. This longitudinal stiffener was located below the stringers, and thus the stringers could be swung in freely without interference at that end away from the outstanding legs of the vertical stiffeners.

The main structure, as now standing, is a prime example of teamwork between designer and fabricator. The result proves that such cooperation, which modifies the construction to utilize most effectively the available fabricating and erecting facilities, pays real dividends in a better structure and, usually, in a financial saving.

JOSEPH SORKIN,⁶ M. ASCE.—Among the topics in this paper is a discussion of the modification of AASHO specifications as regards the design of main compression members. These specifications, as well as other standard design

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specifications, are intended for relatively short spans. In the design of longer spans it behooves one to explore the fundamental concepts regarding the stability of thin plates in compression. The importance of the structure under consideration fully justifies the more thorough and accurate approach to the problem from the standpoint of safety as well as economy. The designers of the bridge are to be commended for that reason.

For relatively heavy reactions of a long span of the magnitude of the Veterans Memorial Bridge, a line bearing is definitely preferable to the conventional shoes in which pins transfer the loads to the supports. Forces

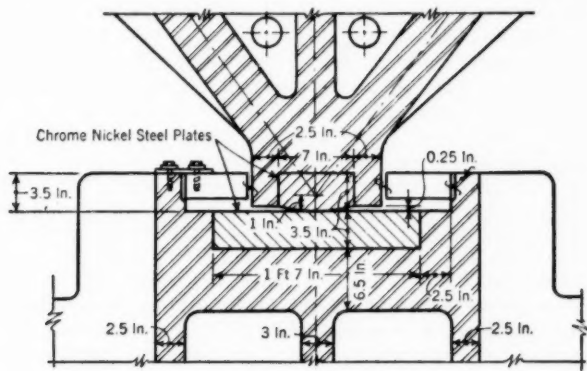


Fig. 3.--Bearing Surfaces.

engendered by pin-type shoes, in the frictional resistance to articulation, may cause significant secondary stresses in the truss members in the immediate vicinity of the bearing, as well as adversely affecting the supporting piers. The type of shoe used for the Veterans Memorial Bridge has been used in several long-span bridges. Instead of special alloys for the bearing slabs, it has been found advantageous to provide inserts of chrome nickel alloys into slabs made of ordinary cast steel. The inserts, made of alloy with a high elastic modulus, may be subjected to considerably higher bearing concentrations. Fig. 3 shows the details of this arrangement. The chrome nickel plates are press fitted into the shoes, the bearing surface of the upper plate having a radius of 8 ft. Incidentally, the same type of bearing may also be used for expansion shoes by setting the lower casting on alloy rollers.

Vertical dimensions of the truss framework at the ends of the 470-ft end spans are not given. As shown in Fig. 1, it appears that the inclination of the end posts is at an unusually acute angle. In certain instances it has been that with end posts sharply inclined there is a tendency toward considerable vibration of the span under live load. This condition apparently results from the fact that the framework in the immediate vicinity is subjected to bending moments analogous to a rigid frame, thus resulting in correspondingly greater deflections.

Details of structures are important and their description is of interest. However, the writer is of the opinion that a recorded history of the principal

aspects of planning and construction of projects of this magnitude is of even greater importance and interest. Thus, the value of the paper could be greatly enhanced if, in addition to the details described by the author, information were furnished as regards other basic problems related to the project. It is hoped that in the closing discussion the author will present the following data:

1. Conditions dictating the lengths of spans;
2. Other types of structures considered and the reasons for adopting cantilever trusses;
3. Basis for establishing the length of the suspended span and of the cantilever arms as used;
4. A description of erection methods employed for the superstructure;
5. Any other controlling data relative to the design and construction of the bridge; and
6. A general breakdown of cost including unit prices for principal construction items.

A. L. R. SANDERS,⁷ M. ASCE.—The discussion that this paper has received and the additional design and construction problems to which the discussers draw attention are most gratifying.

Mr. Jameson is correct in his recommendation that further tests be carried out with respect to the question as to whether b , in the expression for the (b/t) -ratios for components of compression members, should be the full width of the plate or the distance between the nearest lines of connecting rivets.

The type of shoe shown in Fig. 3 is an interesting variation from that shown in the paper. The writer believes that Mr. Sorkin's design would show greater economy as the load to be carried increases, when compared with that used at East St. Louis. Mr. Sorkin's remarks with respect to the inclination of the end post drew attention to an error in the proportions of Fig. 1. The end post has a rise of 45 ft in a distance of 50 ft, and the depth of the center span is 50 ft.

For complex reasons, as stated by Mr. Jameson, the selection of the type of structure, the determination of the span lengths, the relative length of the suspended span and the cantilever arms, and the design of the main members had to be accomplished in a short period of time. Studies made by the designing engineers indicated that a cantilever structure having the ratios (anchor span to center span) finally adopted would be the most economical.

The length of the center span and the location of Piers No. 9 and 10 were conditions established by the United States War Department in the issuance of the permit for the construction of the bridge. The span length and pier location were affected materially by the Eads Bridge, which spans the Mississippi River approximately 800 ft downstream from the site of the East St. Louis Veterans Memorial Bridge. The project was constructed with a lump sum type of contract, and unit prices for the various construction items are not available.

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DISCUSSION OF DEVELOPMENT OF THE CHEMICAL AND
ALLIED INDUSTRY IN THE SOUTH
PROCEEDINGS-SEPARATE 226

R. A. Kampmeier,¹ M. ASCE.—Mr. Hoyer is to be commended on his informative and readable statement. He has painted a clear picture, not only of the industrial growth that is taking place in the South, but also of the diversified resources upon which the industrial development of the region is based. He has performed a very useful service in bringing together brief discussions of some of the South's important resources, and also in illustrating how they affect the selection of plant locations.

The reader of this paper can appreciate the importance of a well-rounded resource base. If a region or a particular locality is to be attractive to an industry, all the ingredients for the successful establishment of that industry should be present. Many of these ingredients are the same for a wide variety of industries: abundant water of good quality, ample low-cost power, efficient transportation, satisfactory labor supply, and attractive community environment. If an area is to provide fertile ground for industrial development, it is not enough that it should have cheap labor or provide tax incentives. Its land and water resources should be developed as completely and upon as well-integrated a basis as possible.

Mr. Hoyer has made a happy choice of words in referring to petrochemicals as "building blocks." The South is now producing "building blocks" of several kinds, including other chemicals, light metals, and the greatly expanded supply of electric energy. Industry in the South has long provided raw materials for industry in the North—not always to the benefit of the South. It seems reasonable to hope that the light metals, synthetic fibers, et cetera, which the South is now producing, will gradually lead to the development in the South of industries which will use these "building blocks" to produce finished consumer goods. This trend will accelerate as the South provides a better market for consumer goods; conversely, the employment of southern labor in such industries will provide them with the wages which will make the South a better market.

There is a lesson for the South in Mr. Hoyer's paper. The South should recognize and study the strong and weak points in its resource picture. It should uncover its latent resources and develop them in an economic and well-integrated manner to permit their utilization for the establishment and growth of a diversified industrial economy. The South should note well the importance, as brought out by the author, of community attitudes toward industry and of the facilities available in the community for the education, recreation, and comfortable living of an industry's employees.

We trust that the North, on its part, will recognize that although the South has come a long way in industrial development, it still has a very long way to go. The South still lags far behind the North in industrial development, and in income levels. The North must recognize that a developing South means better business for the North, that a stronger South means a stronger nation. Any jealousy of the growing strength of a weaker region of our country should be

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put behind us, together with any fears of technological development. As the author noted, the South as a producer of cotton has been fearful of the development of synthetic fibers; likewise, the coal industry has been fearful of hydroelectric developments, et cetera. Time proves such fears to be groundless. Wise development of our resources will benefit, in due course, the local region most directly affected and the rest of the nation as well.